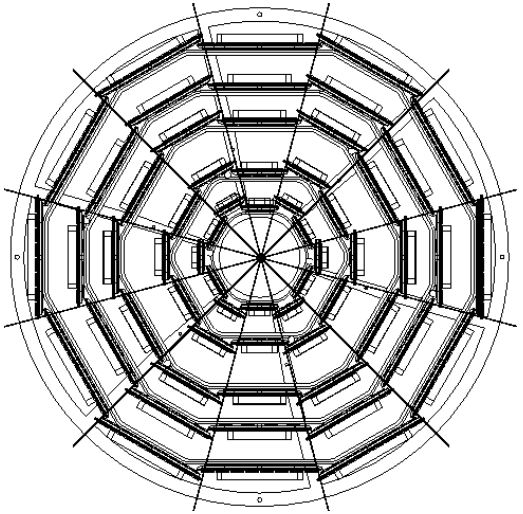
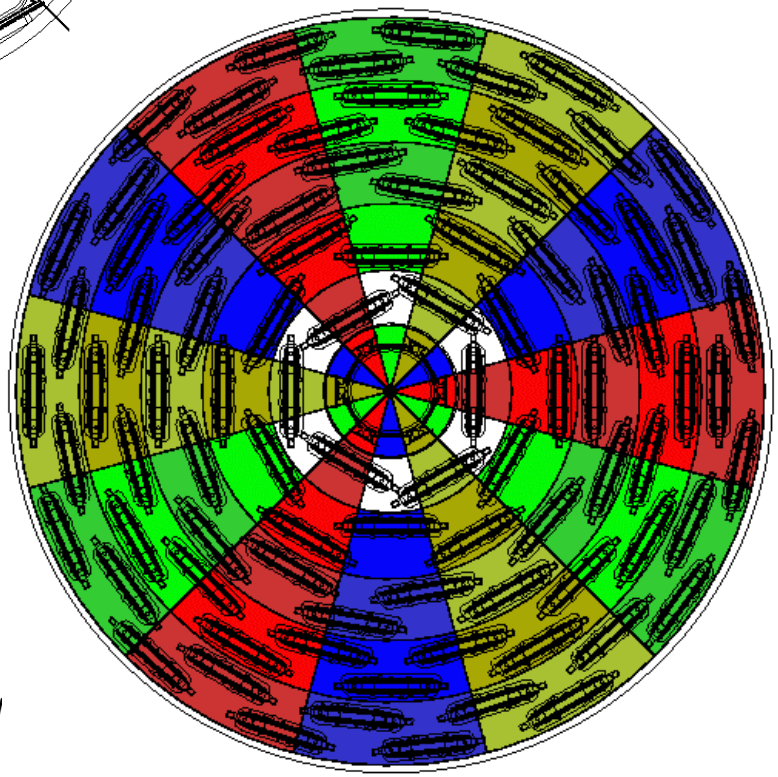
SVT Changes for SVX 2b Geometry

- Two of SVT's design assumptions no longer hold for Run 2B silicon detector
  - **Perfect 12-fold "wedge" symmetry**
  - **Measurement layers whose radii can be approximated as constant within a wedge**
- Can be addressed with minor modifications
  - **Add 12 Merger boards**
    - produce additional boards from existing design
  - **Upgrade Fitter boards**
    - extend current design



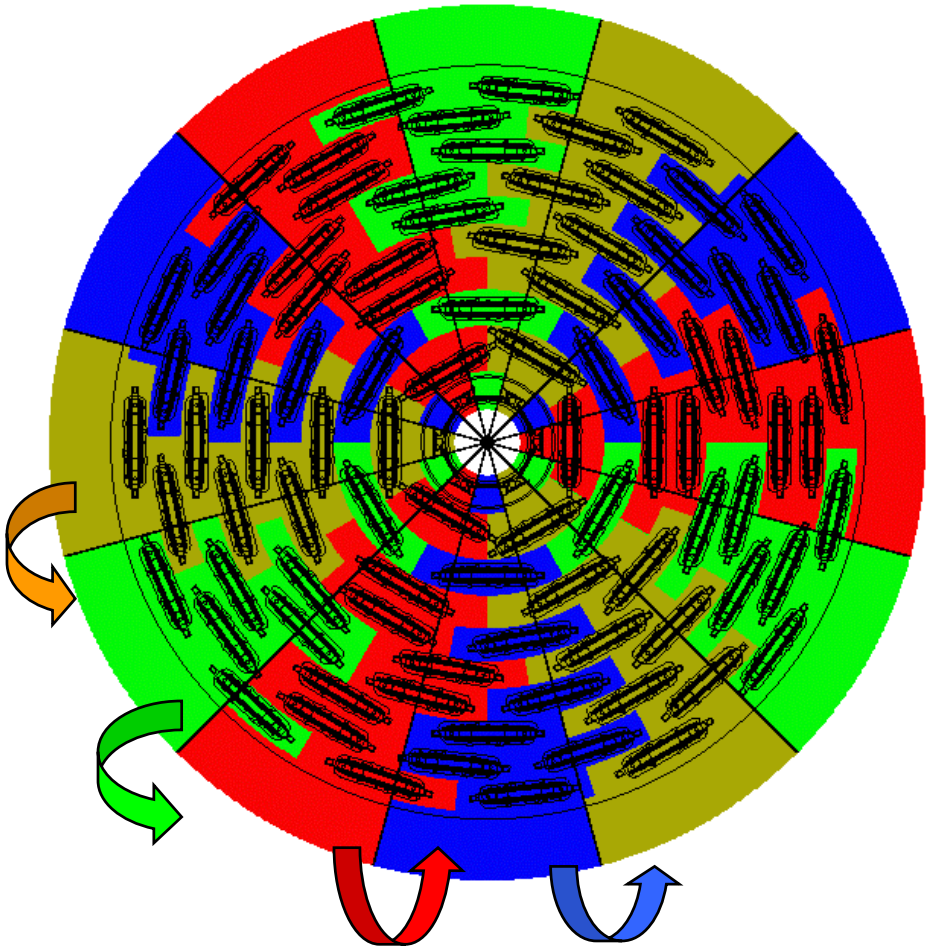
Run 2A geometry



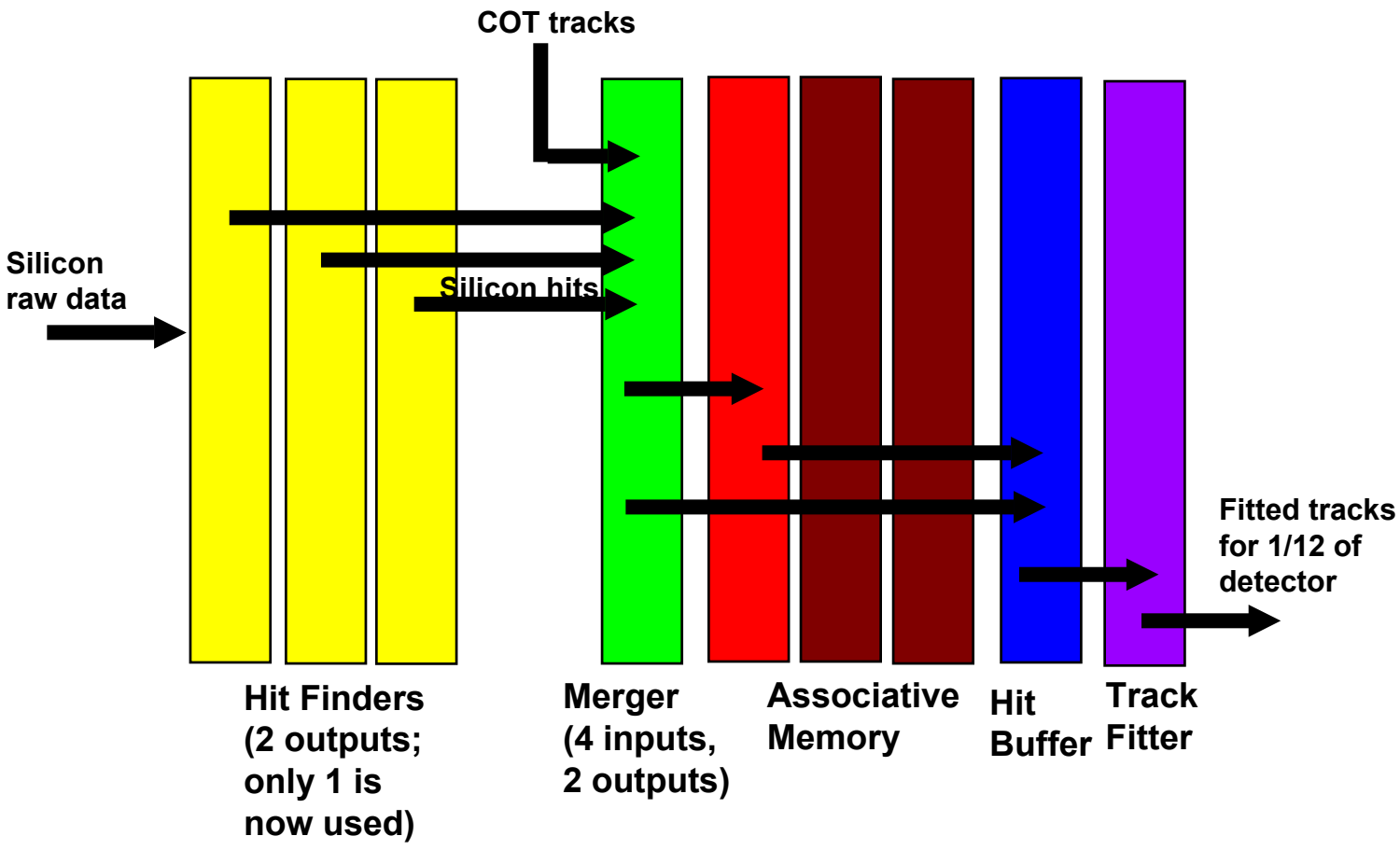
Run 2B geometry

Recovering "wedge" geometry for SVT

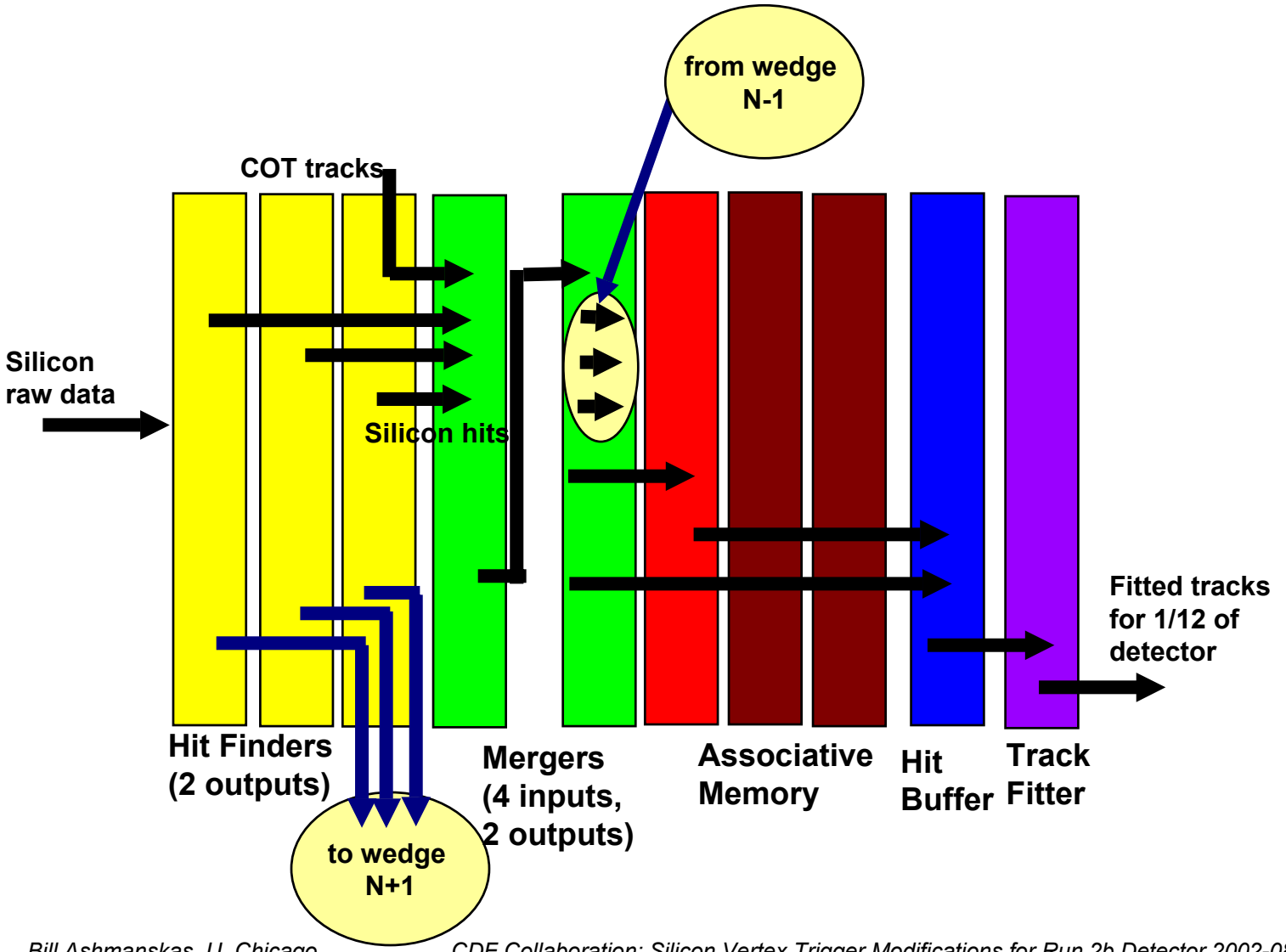
- SVT is built as 12 identical units, finding/fitting tracks in parallel
  - **1/12 of SVT processes 1/12 of detector in azimuth**
- In upgraded detector, some staves in outer layers span SVT wedge boundaries
  - **These staves' hit data must be split among two SVT wedges**
  - **Detector will be cabled such that data only feed forward in azimuth, never backward**
    - Detector data received by Hit Finders in SVT wedge N can be used for tracking in SVT wedges N & N+1
  - **SVT wedge N receives some hits from wedge N-1, forwards some hits to wedge N+1**



Run 2a SVT data flow (per wedge)



Run 2b SVT data flow (per wedge)



SVT Track Fitter Changes for SVX 2b Geometry

- SVT TF performs fast, linearized fit in FPGAs
  - **6 measurements → 3 parameters plus χ^2**
    - $(c, \phi, d, \chi_1, \chi_2, \chi_3) = \vec{p} = \vec{p}_0 + V \cdot \vec{x}$
  - **Uses road ID to reduce bits in multiply**
    - $\vec{p} = \vec{p}_0^{\,\text{road}} + V \cdot (\vec{x} - \vec{x}^{\,\text{road}})$
  - **250 nsec per track fit!**
- For a given set of layers, coefficients are constant across a wedge
- To handle stave geometry, fit coefficients for a given layer combination must vary within an SVT wedge
  - **In present Track Fitters, coefficients are stored in FPGA internal SRAM**
    - 70% of RAM, 60% of logic is used in FIT chip
  - **Number of sets of coefficients needed per Track Fitter will increase by an order of magnitude**
  - **Newer FPGAs can meet this need, without any fundamental TF design change**